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Effects of ASR-based websites on EFL learners' vocabulary, speaking anxiety, and language enjoyment

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ABSTRACT

A vocabulary deficit negatively affects students' language performance. Emotions such as speaking anxiety and language enjoyment in the English as a Foreign Language (EFL) classroom can affect students' achievements as well. We investigated the effects of two Automatic Speech Recognition (ASR)-based websites, *I Love Indonesia* (ILI) and *Novo-Learning* (NOVO), on students' vocabulary knowledge, speaking anxiety, and language enjoyment. A total of 232 secondary school students in Indonesia participated in our quasi-experimental study. They were divided into three groups: two experimental groups received ASR-based intervention (ILI, NOVO), and a control group attended regular classes. Findings revealed that the students from the two experimental groups (ILI and NOVO) significantly outperformed those of the control group: both websites successfully increased the students' knowledge of the targeted vocabulary (40 words), reduced the students' level of speaking anxiety, and stimulated the students' language enjoyment. Additionally, we interviewed 12 of these students and three English teachers. These qualitative outcomes corroborate the quantitative conclusions. Future studies should investigate further benefits of ASR-based websites on speaking skills, especially for long term effects, with in-depth evaluations, as this would help teachers to optimally design and adapt these systems for foreign language learning.

1. Introduction

Vocabulary is pivotal in Foreign Language (FL) learning (e.g., Wilkins, 1972; Schmitt, 2010). Recently, numerous studies have focused on utilizing technology such as videos or other combinations of audio and visual input (Montero Perez et al., 2018; Nguyen & Boers, 2019; Peters & Webb, 2018; Teng, 2020), mobile-mediated glosses (Rassaei, 2020), and a virtual reality application (Tai et al., 2020) to promote vocabulary learning.

One of the more promising technological developments in boosting FL learning is Automatic Speech Recognition (ASR) (Cucchiarini & Strik, 2014). The use of ASR technology in FL learning has been found to benefit learners in enhancing active

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second language (L2) speaking practice, for instance, oral grammar (Bodnar et al., 2017; Penning de Vries et al., 2015) and pronunciation skills (Elimat & AbuSeileek, 2014; Neri et al., 2008). These outcomes indicate that ASR technology may directly contribute to language achievements, a potential benefit that deserves greater scrutiny.

Beyond cognition, FL learning also involves affective factors (Aragão, 2011; Horwitz et al., 1986; MacIntyre, 2002). Two recent meta-analyses by Teimouri et al. (2019) and Botes et al. (2020) concluded that negative emotions such as FL anxiety – including, but not limited to, Foreign Language Speaking Anxiety (FLSA) – can impair learners' language achievement. Studies with regard to the affective part of language learning have started investigating positive emotions as well. Dewaele & MacIntyre (2014, 2016), for instance, showed both a link between FL enjoyment and FL classroom anxiety, and also demonstrated that positive emotions in language learning shape another valuable, affective dimension to L2 learning. Golonka et al. (2014) pointed out in their review study that L2 learners typically report positive experiences when using ASR-based software and that this technology helps enhance their motivation and confidence to practice the language, both being affective variables. Bodnar (2016) showed that corrective feedback generated in an ASR-based Computer-Assisted Language Learning (CALL) system does not negatively affect learners' enjoyment, willingness to practice, or self-efficacy.

Considering (1) the relevance of both cognitive and affective aspects in the FL classroom and (2) the potential of ASR technology, the present study investigates the cognitive effects in vocabulary learning and the affective effects in FL speaking anxiety and FL enjoyment, brought about by practicing with two different ASR-based learning websites (*I Love Indonesia* or ILI and *NovoLearning* or NOVO). In line with the approach in Bashori et al. (2020), we selected two websites instead of only one, to avoid results that are dependent on one specific website. The results in Bashori et al. (2020) also showed that students had positive experiences practicing with these two websites. The present study aims to investigate (1) to what extent the vocabulary knowledge of secondary school students in Indonesia improves as a result of practice with these two ASR-based websites in comparison with traditional practice, and (2) whether and how ASR technology plays a role in reducing FL speaking anxiety and encouraging FL enjoyment.

We address the following research questions for which we hypothesize positive effects of ASR-based practice on both cognitive and affective aspects of language learning:

1. To what extent do ASR-based websites (ILI and NOVO) positively affect secondary school students' cognitive achievement in FL vocabulary knowledge?
2. To what extent do ASR-based websites (ILI and NOVO) positively impact students' affect in FL learning, as measured by FLSA and FLE?

In addition, we address a more exploratory research question concerning the relationship between cognitive and affective features to determine whether vocabulary knowledge, FLSA and FLE correlate and influence language learning experiences.

2. State of the art

2.1. English as a school subject in Indonesia and CALL

English is an international language that plays a pivotal role in global relations and is therefore a compulsory subject in the secondary education curriculum in Indonesia (Department of National Education, 2003; Regional Representative Council of the Republic of Indonesia, 2013). A recent survey shows that Indonesia falls under the low proficiency category (Education First, 2020), suggesting that, despite its popularity, mastering English is a complex challenge for English as a Foreign Language (EFL) learners in Indonesia.

To help increase the level of English proficiency of Indonesian learners, educational institutions have resorted to technology – including CALL. However, while in 'high-resource' settings or developed countries CALL may be viewed as time- and cost-efficient (Sullivan & Lindgren, 2002), in low-resource settings (e.g. Indonesia) a variety of factors appear to hinder CALL from providing an optimum technology-enhanced environment for language learning. Unstable or poor internet connectivity, inadequate technical support, lack of appropriate training (Aryadoust et al., 2016) and limited computer usage and access (Atai & Dashtestani, 2013) are some of the factors that negatively affect CALL implementation. Although the situation may have improved over the last few years, these factors are still relevant to date.

2.2. Computer- and mobile-assisted vocabulary learning

Vocabulary knowledge is a strong predictor of the four basic language skills (Milton, 2013; Miralpeix & Muñoz, 2018; Stæhr, 2008). Recently there have been attempts to promote vocabulary learning through technology-enhanced approaches, such as multimedia annotations (Jones & Plass, 2002), an intelligent mobile phone-based vocabulary tutor (Stockwell, 2007), Youtube videos and blog posts (Arndt & Woore, 2018), mobile-mediated dynamic and nondynamic glosses (Rassaei, 2020), a virtual reality application (Tai et al., 2020), and videos (captions, advance-organizer strategy, and various combinations) (Teng, 2020). Results suggest that the technologies positively affect learners' vocabulary knowledge.

In the educational settings in Indonesia, recent research on technology-based vocabulary learning of Indonesian EFL learners has focused on developing an android-based application (Santosa et al., 2020) and employing various interactive

tools, such as mobile games (Abdulrahman & Jullian, 2020), Quizlet (Setiawan & Wiedarti, 2020), Duolingo (Ajisoko, 2020), and Role-Playing Games or RPGs (Rahman & Angraeni, 2020). The positive results reported by these studies can indeed pave the way for better vocabulary acquisition and development by Indonesian EFL learners.

One potentially promising avenue for technology-based vocabulary learning comes from Automatic Speech Recognition (ASR), a rapidly evolving technology. The increase in the availability of tools which harness ASR technology has led to positive improvements of learners' language skills such as pronunciation (Elimat & AbuSeileek, 2014; Neri et al., 2008) and grammar (Bodnar et al., 2017; Penning de Vries et al., 2015). However, there has been little specific research on the effectiveness of ASR in promoting vocabulary learning, especially in the Indonesian context, which is surprising as ASR enables a form of oral practice that might be particularly useful to overcome speaking anxiety. It is therefore important to investigate how secondary school students in Indonesia experience ASR-based vocabulary learning.

2.3. The impact of technology on learners' emotions in the FL classroom

Emotions experienced in the FL classroom, such as anxiety, play a significant role in students' language learning. Two recent meta-analyses by Teimouri et al. (2019) and Botes et al. (2020) provided firm findings for the negative impact of foreign/second language anxiety on language achievement. If the presence of anxiety is well understood and carefully addressed by teachers, they may be able to create a safe and supportive language learning environment. Having such an environment will facilitate active participation and increase engagement for all learners.

FL anxiety specific to speaking activities in the classroom is known as FL speaking anxiety, which is likely to impair speaking competence. This negative emotion has attracted considerable attention from many scholars in language learning and psychology because, among the four language skills, speaking in an FL has been acknowledged as the most anxiety-provoking task (Horwitz et al., 1986; Palacios, 1998; Price, 1991; see also; Curry et al., 2020; Mukminin et al., 2015). Woodrow (2006) argued that second language speaking anxiety serves as a significant predictor of oral achievement. Such investigations are essential because they provide the useful insight that language learning is not purely cognitive, but also takes place in an affective context. Therefore, an integrated environment is required to help learners overcome their speaking anxiety and improve their speaking performance.

As today's learners are very much exposed to the internet and technology, increasing efforts have been made to develop and employ technology-related tools that help learners reduce their speaking anxiety. Technologies such as Podcasts (Korucu-Kis & Sanal, 2020), TedTalks (Arifin et al., 2020), WhatsApp (Shamsi et al., 2019), Interactive Holographic Learning Support System (Chen, 2018), and Automatic Speech Recognition (Bashori et al., 2020) have been shown to be effective in partly reducing learners' speaking anxiety.

Partly as a result of developments in Positive Psychology (Seligman, 2002), research on emotions in the FL classroom has now shifted from solely investigating negative emotions such as anxiety to studying positive emotions like enjoyment (Dewaele & MacIntyre, 2014, Dewaele & MacIntyre, 2016; Jiang & Dewaele, 2019; Resnik & Dewaele, 2020). The pedagogical implication, according to Dewaele et al. (2018), is that FL teachers should "… strive to boost foreign language enjoyment rather than worry too much about students' foreign language (classroom) anxiety" (p. 676). Reeve (2005) argued that joy, or enjoyment, arises in the circumstances related to experiencing "… desirable outcomes related to personal success and interpersonal relatedness" (p. 316). Dewaele and MacIntyre (2014) explained that language learners frequently give comments on how much they enjoy or do not enjoy a particular language learning activity. It is therefore essential to know whether or not learners enjoy activities in the FL classroom. This also implies that teachers are encouraged to focus more on creating enjoyment in language learning, and technology is considered to be helpful. Technologies that appear to stimulate learners' language enjoyment or positive perceptions are, among others, *CandleTalk* enhanced by ASR (Chiu et al., 2007), corpora (Farr, 2008), virtual world (Shih & Yang, 2008), hybrid game-based app (Berns et al., 2016), and ASR-based websites (Bashori et al., 2020; Chen, 2016).

3. Methodology

The present quasi-experimental study employed mixed-methods research by combining and analyzing quantitative and qualitative data to best capture the phenomenon of interest. A similar methodology employed by Bashori et al. (2020) was found to help conduct the research comprehensively and systematically.

3.1. Participants

Initially, 309 first-year students from nine classes at a vocational high school in Indonesia participated in this study. Seventy seven students had to be excluded from the final analyses because they had not participated in all research stages, from taking the Anglia online placement test to filling in the post-questionnaire on FLSA and FLE and completing the vocabulary post-test. The final number of participants was 232. To ensure that our decision to exclude 77 students did not otherwise influence our results, we compared all the results (vocabulary, FLSA, and FLE) of the final participants ($n = 232$) with those of the larger, initial sample ($n = 309$). There were no significant differences. An overview of the final participants' distribution over the nine school classes is given in Table 1.

The majority of the students (65%) rated their English speaking ability as *beginner*. Regarding how the students evaluated themselves in the English class compared to their classmates, the majority of them (80%) said *average*, while only a few students answered *below average* (15%) or *above average* (5%). Concerning the frequency with which the students spoke English in their daily lives (not including at school), *seldom* (only one or two days in a week) and *never* were the two most chosen responses by 123 (53%) and 96 (41%) participants, respectively. One hundred ninety students (82%) revealed that their speaking skills were affected by inadequate vocabulary, and 176 students (76%) indicated that lack of vocabulary also impacted their speaking anxiety or confidence. This data was obtained through a questionnaire with background questions that preceded the FLSA and FLE questionnaires.

Students usually studied English three hours each week. The classroom meetings occurred twice a week, with each meeting lasting for about 90 minutes. They mainly practiced speaking with their classmates and teachers, very rarely using computers or other technologies to practice speaking. The duration of speaking activities per classroom meeting varied, depending on the learning topics and the teacher's preference. The language of instruction in the classroom switched between English and Indonesian (national language) or Javanese (local language). Additionally, one of the teachers, T01, mentioned that the use of English in the classroom depended on the proficiency level of the students. English was spoken more frequently by the higher proficiency level students.

An Anglia Examination Online Placement Test administered before the study indicated that most participants had a below-A1 level of English proficiency. The participating students were recruited under four representative study programs, taught by three experienced English teachers. We found significant differences between the nine classes in English proficiency level. The reasons for these differences may have related to the students' focus of study. The student level of the Mechanical Engineering study program was better than that of any other program, such as Mechatronics Engineering and Electrical Engineering, as mentioned by T01, one of the English teachers. To deal with potential differences between classes in our study, we divided the classes over the three research conditions, taking into consideration the school's schedule, the distribution of the English teachers, and the distribution of the study programs (see Table 1): experimental group A ($n = 67$; web-treatment using *I Love Indonesia* or ILI), experimental group B ($n = 79$; web-treatment using *NovoLearning* or NOVO), and the control group ($n = 86$; regular teaching with no web-treatment). Differences in English proficiency between classes will be dealt with by including class as a random factor in the statistical analyses.

We also checked whether the students' initial knowledge of the 40 targeted vocabulary items was correlated to their English proficiency level (Anglia version). The results showed that the vocabulary pre-test reflected the curriculum independent Anglia-based test outcomes ($r = 0.664$, $p = .000$).

3.2. Procedure and instruments

The seven steps in this study and the instruments used are as follows:

3.3. Placement test

We first administered the Anglia Examination Online Placement Test (https://www.anglia.org/placement-test). This placement test is a standardized English test widely used to measure EFL learners' proficiency level. There are 100 questions, but the test is shorter for lower levels. Anglia Examination levels can relate to the CEFR level; for example, the *Preliminary* level in Anglia is related to the A1 CEFR level. However, the Anglia team stated that "…this does not necessarily mean that there is an exact equivalence between the levels given" (https://www.anglia.org/cefr).

3.4. Questionnaires

The next step was to administer the (pre- and post-) questionnaire on Foreign Language Speaking Anxiety (FLSA) and Foreign Language Enjoyment (FLE). The questionnaire on FLSA was modified from Horwitz et al. (1986) and Öztürk and

Table 1
Participants' distribution over the nine school classes, teachers, and the research conditions.

Class	Condition	Teacher	Participating students
Nautical Studies 1	ILI	T03	19
Nautical Studies 2	NOVO	T03	21
Mechanical Engineering 1	Control	T01	34
Mechanical Engineering 2	ILI	T01	27
Mechanical Engineering 5	NOVO	T01	29
Mechatronics Engineering 1	ILI	T02	21
Mechatronics Engineering 2	NOVO	T02	29
Electrical Engineering 1	Control	T02	28
Electrical Engineering 2	Control	T02	24

The participants were aged 14–17 years, with an average age of 15 years. The majority of the participants had learned English for between five and 10 years. There were 222 male and only 10 female students. This unequal distribution is due to the study programs chosen mostly by boys.

Gürbüz (2014). Bashori et al. (2020) tested the FLSA items, and the reliability of these items was high (Cronbach's Alpha value = 0.802). The questionnaire on FLE was based on Dewaele and MacIntyre (2014). There were 18 items on FLSA and 10 items on FLE (see Table B1 and B2 in Appendix B). The questionnaires were translated into *Bahasa Indonesia* by the first author, and rechecked by a proficient bilingual Indonesian-English speaker.

3.5. Vocabulary test

The following step was to administer the vocabulary (pre- and post-)test. For the vocabulary (pre- and post-) test, the authors first selected 40 English vocabulary items to be studied by the participants (see Table A1 in Appendix A). These items were derived from the narrative text entitled *Malin Kundang*, which is included in the current English language syllabus and curriculum for the tenth grade in Indonesia. The vocabulary test consisted of three parts (see Appendix C), namely (a) receptive vocabulary test; multiple-choice – choosing one correct meaning from the four options for each given English word (40 test items), (b) receptive vocabulary test; matching English words with their correct Indonesian translations (40 test items), and (c) productive vocabulary test; filling in the gaps with the suitable English words for the given contexts (40 test items). The vocabulary test was modified from Ma and Kelly (2006).

3.6. Web-experiments

Next, we conducted two types of web-experiments with two experimental groups (ILI and NOVO). The web-experiments lasted for about 360 minutes (six hours) divided into four sessions over approximately two weeks. The total duration of the sessions correspond to the lessons scheduled in the national English language subject syllabus. The experimental group A used ILI, while the experimental group B tried NOVO. The web-experiments were conducted in the school's computer laboratory and required a stable internet connection during the learning process. The web-activities started with students watching two videos related to the learning topic (the folklore narrative *Malin Kundang*) in *i-watch*. The first video contained this narrative in English, and the second one gave a further explanation. Then, the participants were asked to read information about the narrative text in *i-read* and to choose one of two special-sounding audio versions they would hear in *i-hear*. Next, the participants learned how to pronounce the targeted words with feedback in *i-pronounce* and *i-speak*; the meaning of each word in Indonesian was also presented in this part. ILI only provided simple feedback in the form of 'excellent' (correct) or 'try again' (incorrect) response on users' pronunciation, while NOVO gave specific feedback on phonetics. The researcher remained present during the web experiment. Below are the screenshots of two activities (*i-hear* and *i-pronounce*) in ILI and NOVO (See Figs. 1, 2, 3 and 4).

3.7. The control group

The control group had a similar amount of learning time, but they did not receive any web-intervention. The control group students attended the regular classes using the same learning topic of *narrative text* within the allotted time. One of the two teachers in the classes of the control group (see Table 1) used the same folklore video, created in-class groups, and asked the students to (a) discuss retelling the story of *Malin Kundang* with their own words and (b) give a presentation by reading the

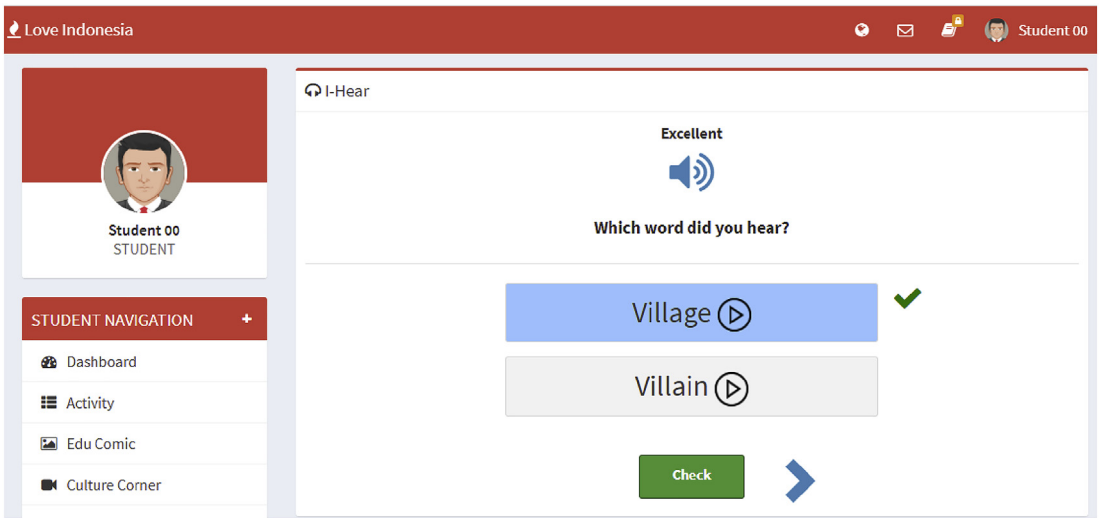

Fig. 1. Example of *i-hear* in ILI.

story (part by part) - for this activity, the students were randomly chosen by the teacher. The other teacher also used the same folklore narrative, asked the students to print the narrative-text sample, and organized discussions in small student groups. There were no folklore video and presentation sessions.

3.8. Interviews with students and teachers

For the interview session, the participants were selected so as to ensure relevant and representative characteristics, with six students per experimental group. The 12 students were recruited based on (a) their proficiency levels, (b) their scores on the vocabulary pre- and post-tests, (c) the levels of FLSA and FLE before and after the treatment, and (d) the first author's note-taking during the observation. The three teachers selected for interviews were those in charge of teaching EFL in the participating classes. The interview questions for the students were modified from Moyo (2011) and, for the teachers, we personalized the questions based on the need of the study. All the interview sessions were carried out in Indonesian. Due to the coronavirus outbreak, some sessions had to be conducted online via *WhatsApp*.

3.9. Website materials

Two speech-enabled websites were employed in this study: *I Love Indonesia* (abbreviated as ILI) and https://www.novo-learning.com/or *NovoLearning* (NOVO). ILI was designed by the first author and his partners and had been used in two previous studies in the Indonesian context, one in which ILI was not equipped with ASR (Bashori, 2018) and one in which ASR had been incorporated in ILI (Bashori et al., 2020). The findings indicated that students had positive perceptions and evaluations of the website.

A second web-application program, NOVO, was employed to gain better insights into the use of speech-enabled websites for language learning. NOVO is a product developed by a spin-off company from the Faculty of Arts of Radboud University Nijmegen, the Netherlands. The web-application program was chosen in this study due to the positive results obtained in a pilot project with 354 Indonesian university students (Research Report, NovoLearning, 2019). The research conducted by the NOVO team revealed that the participants successfully improved their English oral proficiency skills through NOVO.

In the present study, the participants in the two experimental groups (ILI and NOVO) were instructed to perform at least five main web-activities, namely (1) *i-watch* (non-ASR; receptive skill), (2) *i-read* (non-ASR; receptive skill), (3) *i-hear* (non-ASR; receptive skill), (4) *i-pronounce* (ASR-based; productive skill), and (5) *i-speak* (ASR-based; productive skill).

4. Results

4.1. The effects of ASR-based websites (ILI and NOVO) on students' vocabulary knowledge

A total of nine classes divided over three conditions (control group, experimental group A (ILI), and experimental group B (NOVO) participated in the study. Before and after the intervention all participating students ($n = 232$) took the vocabulary pre- and post-tests, which aimed to investigate their initial and final mastery of the 40 targeted words .

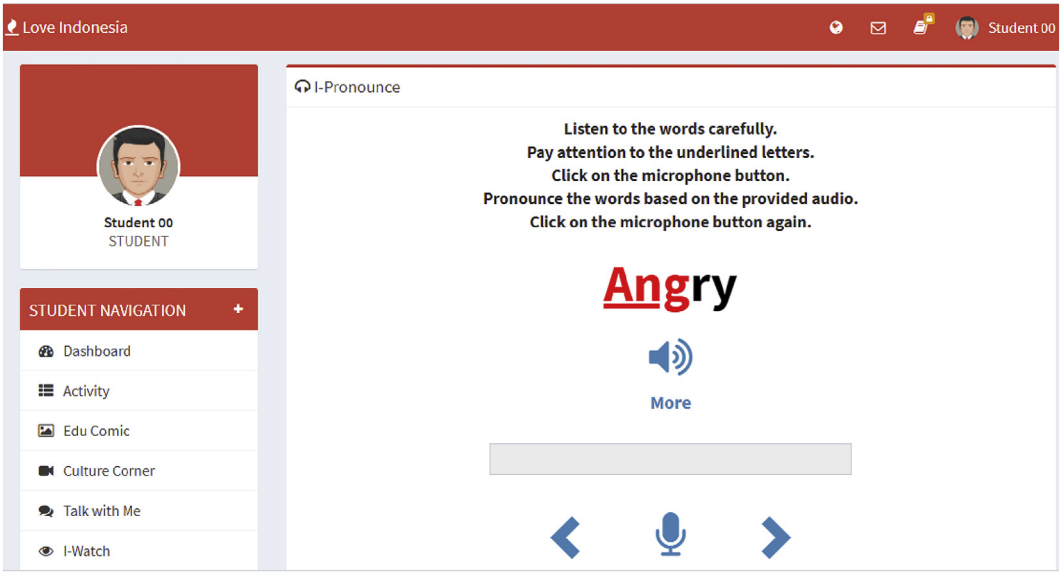

Fig. 2. Example of *i-pronounce* in ILI.

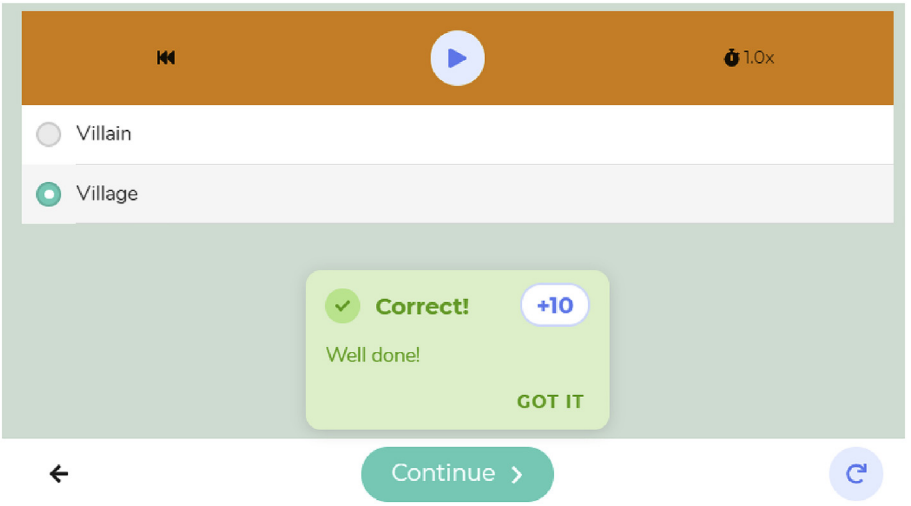

Fig. 3. Example of *i-hear* in NOVO.

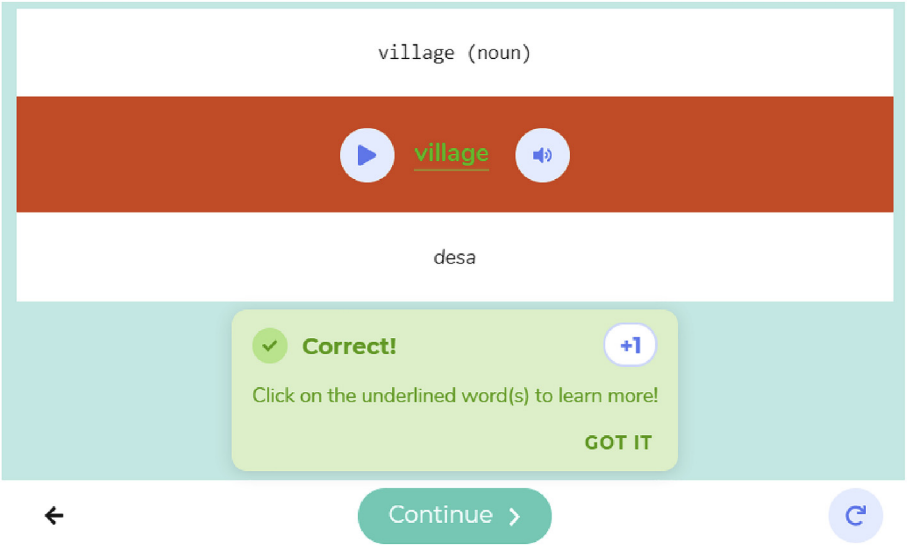

Fig. 4. Example of *i-pronounce* in NOVO.

The results showed that the reliability of the vocabulary test was high (Cronbach's alpha = 0.83). The correlations between the three parts and the total score were high, both in the pre-test and the post-test (correlations were 0.81 or higher). To measure vocabulary, the score on the whole test was used. The mean scores of the vocabulary pre- and post-tests from the three groups (the control and the experimental groups) and their 95% confidence interval are given in the bar charts of Fig. 5.

To investigate the differences between the results of pre- and post-tests on vocabulary knowledge, the gain scores of the students were calculated. We applied linear mixed modeling with class as a random effect (classes are nested under condition) and the three conditions as a fixed effect (R package lme4). Both experimental groups differ significantly from the control group having higher gain scores (the control group being the reference point; ILI, $t = 5.638$, $p = .000$; NOVO, $t = 8.892$, $p = .000$). Post-hoc comparisons (R package emmeans) show that all pairwise comparisons are significant, except between ILI and NOVO. The gain scores for NOVO are higher than for ILI, as can be deduced from Fig. 5, but the difference is not significant ($t = -2.908$, $p = .057$).

As a follow-up, the students in the two experimental groups ($n = 146$) were asked some additional questions regarding the effect of speech-enabled websites (ILI and NOVO) on their vocabulary knowledge. One hundred sixteen of the participants mentioned that overall, learning through ILI or NOVO could improve their English vocabulary knowledge. Specific questions related to the use of ASR-based features on the websites, such as *i-pronounce* and *i-speak*, were also asked. The majority (78%) said that the ASR-based features helped them learn English vocabulary.

4.2. The effects of ASR-based websites (ILI and NOVO) on students' FLSA and FLE

FLSA and FLE after the learning activities were measured using the same questionnaire employed before the treatment. The results indicated high reliability with Cronbach's alpha values of 0.92 (for FLSA items) and 0.88 (for FLE items).

The mean FLSA and FLE scores and their confidence intervals are visualized in the bar charts of Figs. 6 and 7. To test the differences between the pre- and the post-tests, gain scores were computed and analyzed by applying a mixed linear effects regression with class as a random effect and the three conditions as a fixed effect (R package lme4).

The FLSA gain scores of the control, ILI, and NOVO conditions were −0.053, −0.642 and −0.704, respectively. Both experimental groups differ significantly from the control, ILI and NOVO having higher gain scores (the control group being the reference point; ILI, $t = 3.597$, df = 229, $p = .013$; NOVO, $t = 4.039$, df = 229, $p = .009$). Post-hoc comparisons (R package emmeans) show that the gain scores for ILI and NOVO are not significantly different ($t = 0.377$, df = 6.22, $p = .926$). A one sample *t*-test on the gain score of the control condition shows that there are no significant differences between pre- and post-test (test value = 0, $t = -0.843$, df = 85, $p = .402$).

The FLE gain scores of the control, ILI, and NOVO conditions were 0.052, 0.321, and 0.203. Both experimental groups differ significantly from the control, ILI and NOVO having higher gain scores (the control group being the reference point; ILI, $t = 3.634$, df = 229, $p = .000$; NOVO, $t = 2.409$, df = 229, $p = .017$). Post-hoc comparisons (R package emmeans) show that the gain scores for ILI and NOVO are not significantly different ($t = 1.297$, df = 6.53, $p = .493$). A one sample *t*-test on the gain score of the control condition shows that there are no significant differences between pre- and post-test (test value = 0, $t = 0.988$, df = 85, $p = .326$).

Additional questions related to the effects of speech-enabled websites on FLSA and FLE were asked of the students in the two experimental groups ($n = 146$). Most participants ($n = 102$) mentioned that they liked learning English using the speech-enabled websites (ILI or NOVO). The majority of the participants (77%) also believed that using the ASR-based features provided by the websites (ILI and NOVO) helped them reduce their anxiety in speaking English compared to speaking with friends, teachers, or other people.

The participants were also asked whether the use of an Indonesian folklore narrative (instead of foreign narratives), in this case, *Malin Kundang* from West Sumatra, might have contributed to creating a relaxing and less anxiety-provoking atmosphere. Seventy percent of the participants answered that using a local, familiar narrative made them feel more relaxed and less anxious during their learning activities.

4.3. Do the relationships between cognitive achievement and the two affective variables change?

To investigate the relationships between vocabulary knowledge, FLSA, and FLE before treatment, we calculated Pearson correlations. The three correlations are given in Table 2.

Table 2 shows that, at the pre-test, there were no significant correlations except for a significant negative small correlation between FLSA and FLE ($r = -0.269$). Higher levels of FLSA are associated with lower levels of FLE, but the two affective variables are for the most part independent. The non-significant correlations between the two affective variables and vocabulary knowledge suggest that FLSA and FLE can have varying values at different levels of vocabulary knowledge.

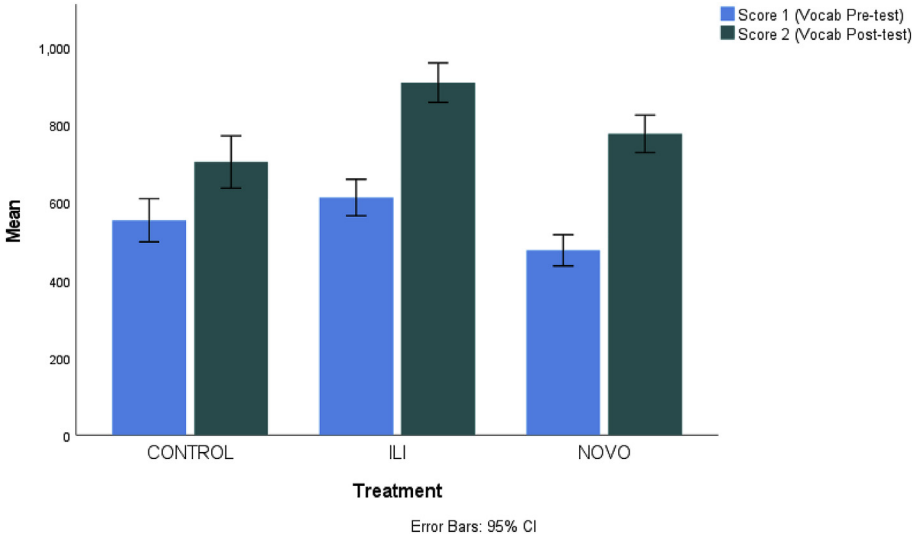

Fig. 5. Bar chart of the Pre- and Post-test Scores on Vocabulary by Control and Experimental Groups.

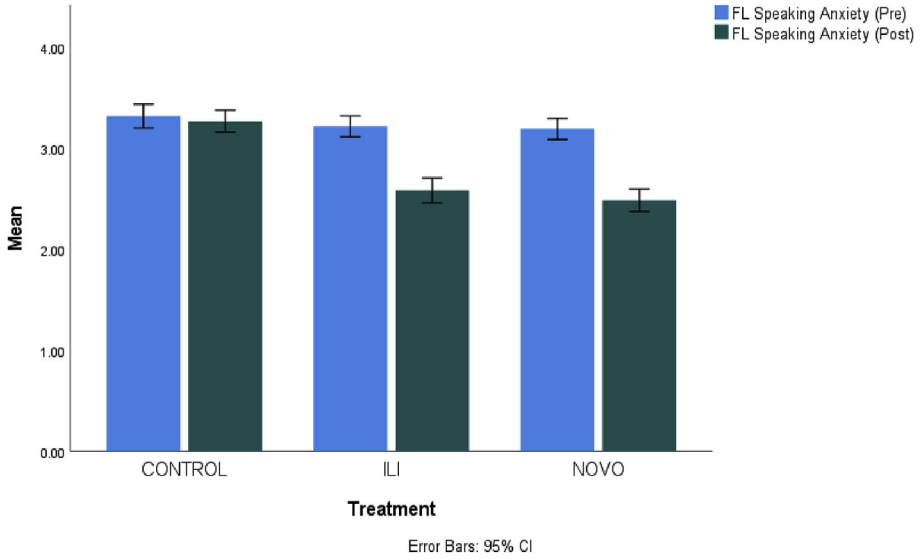

Fig. 6. Bar chart of the Pre- and Post-test Scores on FLSA by Control and Experimental Groups.

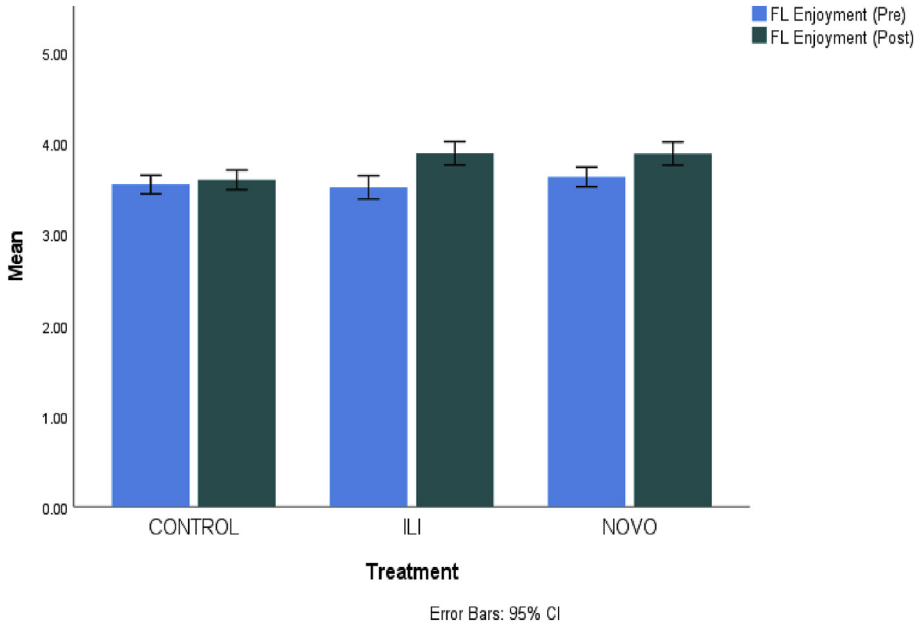

Fig. 7. Bar chart of the Pre- and Post-test Scores on FLE by Control and Experimental Groups.

When we compared the changes in size of these correlations in the pre- and post-tests, we found significant changes in the correlations between FLSA and FLE in the two experimental groups, but not in the control group (ILI, $n = 67$, $r_{pre} = -0.137$, $r_{post} = -0.612$, p(two-sided) $= 0.001$; NOVO, $n = 79$, $r_{pre} = -0.217$, $r_{post} = -0.627$, p(two-sided) $= 0.001$; control, $n = 86$, $r_{pre} = -0.397$, $r_{post} = -0.337$, p(two-sided) $= 0.652$). The correlation between the two affective variables changed from small in the pre-test to moderate/large in the post-test in the two experimental groups.

4.4. Evidence from the in-depth interviews

Twelve students from the two experimental groups were selected to take part in an in-depth interview in Indonesian. These interviews were carried out to collect additional information on the students' experiences with the ASR-based websites. Overall, the interviewees felt positive about using the websites for EFL learning and stated that the websites were user-

Table 2
Correlations between the pre-test Vocabulary, FLSA, and FLE scores (p two-sided, $n = 232$).

	FLSA	FLE
Vocabulary	.014 (p = .836)	.108 ($p = .100$)
FLSA		-.269 ($p = .000$)

friendly and helped them learn English. When asked for recommendation ratings (how the participants would recommend the websites to other students) on a five-point scale, both websites received the same high mean score of 4.58.

Regarding vocabulary learning, Participant NOVO03 mentioned that: *"On the website (NOVO), I can learn vocabulary that I don't know yet in advance and (learn) how to pronounce the words."* Participant ILI01 added that: *"(By using ILI) I could understand English word by word and could use the words."* He also said that speaking practice (provided by the ASR-based features) increased his confidence because he had acquired vocabulary from the web-application program.

However, there were some aspects of the websites (ILI and NOVO) that the participants did not like. Participant ILI02 said that one of the speaking features on ILI did not work properly; *"It (i-speak) is difficult."* Participant ILI03 also complained that it was hard to get her voice-response to be recognized correctly when using *i-speak* on ILI. Participant NOVO01 mentioned that: *"When speaking, (sometimes) I have already spoken or pronounced the words correctly, but the system (sometimes) failed to recognize or gave me the wrong feedback."* Participant ILI02 said that he would prefer to have a coloured background, such as green, and more pictures on the website (ILI).

Participant NOVO05 said that if she had to change something on the website, she would change the initial or main display (user interface). For example, instead of having a 'right arrow' icon on the features such as *i-read* or *i-watch*, she would replace that icon with an icon of 'a person who is reading' (for *i-read*) or 'a person who is watching' (for *i-watch*).

The websites were positively evaluated with respect to speaking anxiety and language enjoyment. Participant NOVO01 - who initially indicated a high level of FLSA (with the mean score of 4.0) - significantly reduced his FLSA after using NOVO, even in the regular classroom environment:

> The positive effect is I am not nervous when speaking (English). (Speaking practice through NOVO also) really adds (my confidence), (for example) during the learning activity (in the regular classroom), when asked to come in front (of the classroom) to read a text, I did not feel nervous, and I could.

Another participant, NOVO03, said: *"I was helped (by NOVO in learning English), and I like English now."* Participant NOVO04 also responded that NOVO helped him become less afraid of making mistakes (when answering the questions) because he could repeat the questions. In addition, Participant NOVO05 stated that when using NOVO, learning (English) became less boring; however, her FLE score indicated a slight decrease from 4.7 to 4.4.

A participant from the ILI group, ILI03, seemed to enjoy using the website for language learning. She stated that the website was easy to use, helpful for the students, and made her more interested in learning English. What Participant ILI05 liked in ILI was: *"I could watch the video of Malin Kundang in English and then practice speaking English correctly."* Additionally, Participant ILI01 said that he liked the feature of *Wall* on ILI, where posting comments was possible for the users; the feature of *Wall* here is similar to (and inspired by) the popular feature provided by *Facebook*. However, the same participant showed no change in FLSA (with a mean score of 3.1) and a slightly positive change in FLE (from 3.3 to 3.5).

Interviews with three English teachers, who were in charge of teaching the students in the control and experimental groups, revealed that most of their students had limited vocabulary knowledge, which might have affected their English performance. All the teachers had tried out some features on the websites (NOVO and ILI), and agreed that the ASR-based websites could help promote vocabulary learning by the students. Teacher T01 said: *"(The ASR technology) really helps the students accelerate their mastery of vocabulary."* Teacher T02 and T03 mentioned that ASR technology also supported the students in learning how to pronounce the words correctly. However, Teacher T01 would prefer an android-based application program, which should (1) be monitored by the school and the teachers, (2) be supported with a stable internet connection, and (3) show how to spell and pronounce words correctly, the meaning of the words, and the part of speech.

In conclusion, students and teachers evaluated both websites (ILI and NOVO) positively, corroborating the quantitative results. Regarding ASR technology, technical issues need to be solved in order to optimize its potential for oral activities, especially in the FL classroom.

5. Discussion

The present study addressed two research questions related to the effects of ASR-based websites on learners' cognitive achievement (vocabulary knowledge) and learners' affect (FLSA and FLE). We investigated both these cognitive and affective aspects in the context of FL classrooms at a secondary vocational high school in Indonesia. We claimed that these three areas under investigation – vocabulary knowledge, FLSA and FLE – are all essential and potentially serve to enhance and coordinate successful FL learning, which is important in the context where this study was conducted – Indonesia – where the government has been striving to increase the students' level of English proficiency.

The three domains or constructs under investigation – vocabulary knowledge, FLSA, and FLE – did not exhibit strong correlations. We might expect that better vocabulary knowledge is associated with lower levels of FLSA and higher levels of FLE. However, enjoyment and anxiety might supposedly be affected by personality traits as well as by differences in social and cultural background. We found that FLSA and FLE exhibit varying values within the restricted range of vocabulary knowledge we investigated, as all our participants basically follow the same curriculum for English as a foreign language. Given our short intervention (six lessons in duration) to find positive changes in the three domains is promising. The presence and type of causal patterns between the three constructs involved requires another type of investigation. The central issue here is not to determine which of these areas is the most relevant, but instead, to focus on *how* to create a classroom atmosphere and learning resources that can support language learning, vocabulary learning in our specific case (cognitive component), and, at the same time, trigger learners' positive emotions.

Regarding cognitive factors, both experimental groups, ILI and NOVO, had significant gain scores in vocabulary knowledge. This is an interesting finding as insufficient vocabulary knowledge has been identified as one of the factors triggering speaking anxiety. Traditional vocabulary learning approaches focus on more passive, receptive learning, while ASR technology allows the kind of productive, oral practice that is necessary to overcome speaking anxiety. We employed a traditional written vocabulary test assuming that it is adequate to investigate learners' vocabulary knowledge on the targeted words. Admittedly, a spoken vocabulary test might be necessary to thoroughly examine the relationship between vocabulary knowledge and speaking anxiety.

As a matter of fact, we indeed found that both ASR websites reduced Foreign Language Speaking Anxiety (FLSA) and enhanced Foreign Language Enjoyment (FLE) significantly in the experimental groups in comparison to the control group. There were no significant differences between the two websites, in any of the three scores measured. However, NOVO was beset by fewer technical errors, which probably made the students feel less nervous during the learning process. ILI adopted features similar to those in social media such as *Wall (i-Post)* and *Chatting (i-Chat)*, which seemed familiar to the students.

We also delved into the change of relationships between vocabulary knowledge, FLSA, and FLE as a consequence of the ASR-based intervention. We found no significant correlations between vocabulary and FLSA and FLE at the pre-test. Affective components may vary at different levels of vocabulary knowledge. Moreover, despite differences between the Indonesian students, they seemed relatively homogenous in terms of English proficiency, given their shared school history in an Indonesian context. More importantly, we found an increase in correlation between the two affective components, which changed from small in the pre-test to moderate/large in the post-test.

This increase in the strength of the correlation could be taken to indicate that through the treatment the students became more aware of speaking anxiety and enjoyment, and that this might have led to more coherent intuitions about these emotions. The two variables showed a clear negative relationship, and this kind of negative correlation was also found by Jiang and Dewaele (2019) and Resnik and Dewaele (2020), except that those studies did not specifically examine FLSA, but FL Classroom Anxiety. Our results seem to be in line with the conclusion by Dewaele and MacIntyre (2014) that FLSA and FLE "… appear to be independent emotions, and not opposite ends of the same dimension" (p. 261). The qualification of being independent emotions seems to be strong, though. In our study FLSA and FLE are negatively related but, undeniably, they disclose complementary sources of emotional information, suggesting that they are related, but distinct dimensions.

While the studies by Dewaele & MacIntyre (2014, 2016) focused on general Foreign Language Classroom Anxiety (FLCA), our study offers a more specific observation and discussion of one type of language anxiety, FLSA, in conjunction with FLE. Addressing speaking anxiety seemed more appropriate in the context of EFL learning and teaching in Indonesia, where many learners describe feelings of anxiety in speaking EFL. Bashori et al. (2020) also found that FLSA is relatively high in this context, and two recent meta-analyses by Teimouri et al. (2019) and Botes et al. (2020) showed that speaking anxiety contributes to low language achievement. Having a better understanding of how cognitive and affective aspects may interact in FL learning will encourage teachers to create a more stress-free, engaging, fun, and effective classroom environment.

The interviews revealed that, overall, the participants in the experimental groups held positive evaluations of their experiences. The participants believed that the websites positively affected their emotions (reducing FLSA and increasing FLE) and increased their vocabulary knowledge. Additionally, 11 of 12 participants stated that they preferred to have (speaking) practice with the ASR-based websites at the initial stage before practicing with their peers or other people. The participants mentioned three main reasons for this preference: (1) the participants wanted to be ready and fluent first before speaking with people; this is to avoid nervousness or anxiety, (2) the website increased self-confidence, and (3) their speaking could be corrected by the website. This finding is congruent with what Ross et al. (2019) argued, namely that a personalized ASR-based learning system may help enable learners in terms of practicing without fear of making mistakes, using classroom time more efficiently, and building up more confidence.

Three English teachers were also interviewed. They reported that the majority of their students have a vocabulary deficit. When asked about ILI and NOVO for learning English, the teachers mentioned that the ASR-based websites (ILI and NOVO) could be helpful for the students to learn vocabulary. Additionally, the teachers stated that the websites may support the students to learn English pronunciation.

At this point, it is important to check whether these positive outcomes were solely generated by the use of ASR technology or result from a combination of other elements. An important aspect was using an Indonesian cultural narrative. Although this narrative was used in all three conditions, it may have been a stronger incentive in the two experimental groups, where students had to perform individually. It seems to be important to link foreign language learning to the daily lives of secondary

school pupils in Indonesia (see also Lwin & Marlina, 2018; Nyoman & Gana, 2018; Prastiwi, 2015; Sukmawan & Setyowati, 2017).

One of the limitations of this study is that it investigated more boys than girls, which is not ideal. Another limitation of this study, which requires more research, is the effectiveness of ASR technology when used as the only innovative feature in the intervention. The experiment employed not only ASR technology, but also non-ASR features such as *i-watch* (watching two topic-related videos), *i-read* (reading information about the topic), *i-hear* (listening to the targeted words), and some other features, e.g. *i-post* (posting something in the *Wall*), *i-chat* (text-based chatting with other users), and *i-share* (writing something in private). This was done to follow (1) a logical sequence from receptive skills to productive skills, and (2) the school's guidelines and the national syllabus of the English subject. In conducting the web-experiments, the first author had to take over six classes for two or three weeks. This was because it was not possible at that time to ask the teachers to conduct the experiment (teaching English using the websites) by themselves due to the technicalities of the websites (ILI and NOVO). However, the first author allowed the teachers to be present in the classroom, if they were willing. The teachers preferred not to be in the classroom. They sometimes only checked the classroom situation for a few minutes, and then chose to do other activities at school. In order to help the students (and teachers) not to 'lose' or skip their core materials, we designed the experiments following the learning materials that the students (and teachers) were supposed to learn (and teach) at that time. The learning materials do not only contain speaking activities, but also other language skills (listening, reading, and writing).

6. Conclusions

The present study has revealed positive results on the effectiveness of two ASR-based websites, *I Love Indonesia* (ILI) and *NovoLearning* (NOVO), in the context of teaching English as a foreign language in a vocational high school in Indonesia. Students who received web-based interventions have shown significant cognitive and affective improvements in comparison to students of a control group who were exposed to traditional classroom teaching. Both experimental groups, ILI and NOVO, have shown significant improvements on three aspects: increased vocabulary knowledge, reduced Foreign Language Speaking Anxiety (FLSA), and enhanced Foreign Language Enjoyment (FLE).

No significant differences between the two websites have been found in their effect sizes. In-depth interviews with students and teachers have indicated that despite some critical notes on technical issues, both ASR-based websites have been perceived positively.

Given our promising results, it is important to continue research with ASR-based web-experiments, to acquire knowledge about which features are effective and how much time students should invest. We need experiments with a longer duration, with a variety of students (other school types, more females), and we need to investigate, in addition to vocabulary learning, what the benefits are in terms of pronunciation and fluency, as these aspects have not yet been thoroughly investigated in the Indonesian contexts. Another interesting option would be to investigate the embedding and integration of Indonesian cultural elements, related to the daily lives of secondary school pupils in Indonesia, so as to better situate learning English as a foreign language in the Indonesian educational context.

Author statement

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Declaration of competing interest

No potential conflict of interest was reported by the authors.

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Appendix A

Targeted Vocabulary

There were 40 targeted words in total, as shown in Table A1, taken from the text of *Malin Kundang*, a narrative from the traditional Indonesian folklore from West Sumatra.

Noun ($n = 14$)
Verb ($n = 11$)
Adjective ($n = 10$)
Adverb ($n = 5$)

Table A1
List of targeted vocabulary items

No	Word	Part of speech*	Category**
1	Village	Noun	A1
2	Beach	Noun*	A1
3	Pirate	Noun*	B1
4	Stone	Noun*	B1
5	Son	Noun	A1
6	News	Noun	A2
7	Thunder	Noun*	B1
8	Ship	Noun*	A2
9	Sea	Noun	A1
10	Fish	Noun*	A1
11	Crew	Noun*	B1
12	Harbor	Noun*	B1
13	Wound	Noun*	B2
14	Beggar	Noun*	Unknown
15	Curse	Verb*	Unknown
16	Become	Verb	A2
17	Yell	Verb*	B2
18	Sail	Verb*	B1
19	Regret	Verb*	B1
20	Disobey	Verb	Unknown
21	Hijack	Verb*	Unknown
22	Chase	Verb*	B2
23	Migrate	Verb	Unknown
24	Raise	Verb*	B2
25	Kneel	Verb	B2
26	Rich	Adjective*	A2
27	Strong	Adjective*	A2
28	Late	Adjective*	A1
29	Angry	Adjective	A2
30	Prosperous	Adjective	C1
31	Plentiful	Adjective	Unknown
32	Ragged	Adjective	Unknown
33	Confused	Adjective	B1
34	Stranded	Adjective	C2
35	Saddened	Adjective	Unknown
36	Really	Adverb	A1
37	Suddenly	Adverb	B1
38	Luckily	Adverb	B1
39	Immediately	Adverb*	A2
40	Slowly	Adverb	A2

*The words can function as more than one part of speech.
**This category is based on Cambridge Advanced Learner's Dictionary.

Appendix B

Participants responded to each of the statements below by selecting from one of each of the following five options: 1. Strongly Disagree; 2. Disagree; 3. Neutral (neither agree nor disagree); 4. Agree; 5. Strongly Agree.

Table B1
The Questionnaire on Foreign Language Speaking Anxiety

No	Question Items
1	I never feel quite sure of myself when I am speaking in my English class.
2	I don't worry about making mistakes in English class.
3	I tremble when I know that I'm going to be called upon in English class.
4	It frightens me when I don't understand what the teacher is saying in English.
5	I start to panic when I have to speak without preparation in English class.
6	It embarrasses me to volunteer answers in my English class.
7	I would not be nervous speaking English with native speakers.
8	I get upset when I don't understand what the teacher is correcting.
9	I feel confident when I speak in English class.
10	I am afraid that my English teacher is ready to correct every mistake I make.
11	I can feel my heart pounding when I'm going to be called upon in English class.
12	I always feel that the other students speak English better than I do.
13	I feel very self-conscious about speaking English in front of other students.
14	I get nervous and confused when I am speaking in my English class.
15	I get nervous when I don't understand every word the English teacher says.
16	I feel overwhelmed by the number of rules you have to learn to speak English.
17	I am afraid that the other students will laugh at me when I speak English.
18	I get nervous when the English teacher asks questions which I haven't prepared in advance.

Participants responded to each of the statements below by selecting from one of each of the following five options: 1. Strongly Disagree; 2. Disagree; 3. Neutral (neither agree nor disagree); 4. Agree; 5. Strongly Agree.

Table B2
The Questionnaire on Foreign Language Enjoyment

No	Question Items
1	I don't get bored in my English class.
2	I enjoy my English class.
3	I perform well in my English class.
4	In my English class, I feel proud of my accomplishments.
5	My English class is a positive environment.
6	It's cool to know English.
7	My English class is fun.
8	My peers in English class are nice.
9	There is a good atmosphere in my English class.
10	We laugh a lot in our English class.

Appendix C

Below are sample vocabulary test items.

Part 1

Choose one correct meaning from the four choices for each given word.

1. Village
   a. Desa b. Kota c. Hutan d. Sawah
2. Curse
   a. Memukul b. Mengutuk c. Menampar d. Meninggalkan

Part 2

Match the words with their correct Indonesian translations.

	Berteriak	Sungguh	Pantai	Kuat	Mengutuk	Kaya	Desa	…
Village								
Curse								
…								

Part 3

Please fill in the gaps with the suitable words for the contexts. The initial letter(s) and the Indonesian translations for each missing word have been given.

1. Malin Kundang and his mother lived in a small and quite (v_____). *Desa*
2. Malin Kundang's mother said, "I (c_____) you to turn to stone". *Mengutuk*

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